WE CLAIM:

Sub B1

1. A wire bonding method, comprising the steps of:

forming a semiconductor substrate with a copper (Cu) interconnect material;

fabricating a copper (Cu) bond pad;

depositing a tantalum (Ta) layer onto the substrate;

patterning and etching the tantalum (Ta) layer; and

bonding an aluminum (Al) wire with the tantalum (Ta) layer;

wherein a portion of the tantalum (Ta) layer bonds with the copper (Cu) bond pad, and another portion of the tantalum (Ta) layer forms a tantalum aluminide ($TaAl_3$) compound.

Sub E1

2. The method of claim 1, wherein the wire is a wire selected from the group consisting of an aluminum wire, an aluminum alloy wire, and an aluminum-coated gold wire.

3. The method of claim 1, wherein thickness of the tantalum (Ta) layer is controlled such that a portion of the tantalum (Ta) layer bonds with the copper (Cu) bond pad, and another portion of the tantalum (Ta) layer

forms a tantalum aluminide ($TaAl_3$) compound.

Sub E'

4. The method of claim 1, wherein thickness of the tantalum (Ta) layer is between 300 to 1000 angstroms (Å).

5. The method of claim 1, wherein the aluminum (Al) wire is bonded onto the tantalum (Ta) layer by wedge bonding.

6. The method of claim 1, further comprising the step of performing a heat treatment after the bonding step.

7. The method of claim 1, further comprising the step of packaging the substrate in a package consisting of a plastic package and a hermetic package.

8. The method of claim 1, wherein the tantalum (Ta) layer is patterned by a method consisting of negative tone pad masking, photoresist patterning, and photolithography.

9. The method of claim 1, wherein the substrate is a multi-layered

Sub E1

~~interconnect~~ structure.

Sub A1

10. A wire bonding method, comprising the steps of:

forming a passivation layer on a semiconductor substrate;

bonding a wire onto the passivation layer; and

encapsulating a bond pad made from an interconnect material, wherein the wire is more metallurgically stable than the interconnect material;

wherein a portion of the passivation layer forms a metallurgical bond with the interconnect material;

wherein a mechanical and electrical connection is provided between the interconnect material and the wire, with the passivation layer disposed therebetween.

11. The method of claim 10, wherein the wire is a wire selected from the group consisting of an aluminum wire, an aluminum alloy wire, and an aluminum-coated gold wire.

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12. The method of claim 10, wherein the passivation layer is a tantalum (Ta) layer.

Sub E'

13. The method of claim 10, wherein the wire is bonded onto the passivation layer by wedge bonding.

14. The method of claim 10, further comprising the step of performing a heat treatment after the bonding step.

15. The method of claim 10, wherein the substrate is a multi-layered interconnect structure.

16. A semiconductor device, comprising:

a substrate;

a copper (Cu) bond pad formed on the substrate;

a tantalum (Ta) layer encapsulating the copper (Cu) bond pad;

wherein a portion of the tantalum (Ta) layer bonds with the copper (Cu) bond pad, and another portion of the tantalum (Ta) layer forms a tantalum aluminide ($TaAl_3$) compound.

17. The device of claim 16, wherein the substrate is a multi-layered interconnect structure.

18. The device of claim 16, wherein the tantalum (Ta) layer is bonded with the copper (Cu) bond pad using wedge bonding.

19. The device of claim 16, wherein the substrate is packaged in one of the group consisting of a plastic package and a hermetic package.

20. The device of claim 16, wherein thickness of the tantalum (Ta) layer is between 300 to 1000 angstroms (Å).